**On the Gravitational Force**

February 8, 2016.

José Francisco García Juliá

jfgj1@hotmail.es

The gravitational force would be transmitted through a polarization of the vacuum.

*Key words*: gravitational force, polarization of the vacuum.

From the gravitational redshift [1], it is obtained that the speed of the light in the vacuum, $c$, would be $c - v_{eph} = c - GM/Rc$, where $v_{eph} = GM/Rc$ is the escape velocity of a photon, $G$ the Newton's gravitational constant, $M$ a mass and $R$ its radius. Then

$$\frac{c}{n} = c - \frac{GM}{Rc}$$

$$n = \frac{1}{1 - \dfrac{GM}{Rc^2}} \tag{1}$$

$n$ being a gravitational refractive index.

This would change, respectively, the values of the electric permittivity, $\varepsilon_0$, and the magnetic permeability, $\mu_0$, of the vacuum to the values $\varepsilon = n\varepsilon_0$ and $\mu = n\mu_0$, and the speed of the light in the vacuum would be $1/(\varepsilon\mu)^{1/2} = 1/n(\varepsilon_0\mu_0)^{1/2} = c/n$, instead of only $c = 1/(\varepsilon_0\mu_0)^{1/2}$. Note also that as for $M/R = c^2/G$ it is, from (1), $n = \infty$ and $c/n = 0$, then $M/R < c^2/G$. And $n$ can change from $n = 1$ to $n < \infty$.

Therefore, the presence of a mass would induce an electromagnetic polarization in the vacuum space:

$$<\varepsilon,\mu> \ldots <\varepsilon,\mu> \tag{2}$$

where the symbol $<\varepsilon,\mu>$ represents an electromagnetic dipole.

We postulate that the induced dipoles of (2) would form the lines of force of an electromagnetic attraction force produced by the mass in question.

Hence, we define the corresponding gravitational vector field, $\vec{\Gamma}$, for a mass, as proportional, $k_g$, to the number of lines of force per unit area, $N/S$, per solid angle, $S/r^2$:

$$\vec{\Gamma} = -k_g \frac{N}{S}\frac{S}{r^2}\vec{u}_r = -k_g \frac{N}{r^2}\vec{u}_r \tag{3}$$

$r$ being the radial distance ($\vec{r} = r\vec{u}_r$).

Thus, for the gravitational vector field produced by the source mass, $m_1$, it would be

$$\vec{\Gamma}_1 = -k_g \frac{N_1}{r_1^2}\vec{u}_r = -G\frac{m_1}{r_1^2}\vec{u}_r \tag{4}$$

with

$$k_g N_1 = G m_1 \tag{5}$$

because the mass $m_1$ induces the $N_1$ lines of force of (2).

The gravitational force on a test mass, $m_2$, would be

$$\vec{F}_{g12} = m_2\vec{a}_2 = m_2\vec{\Gamma}_1 = -G\frac{m_1 m_2}{r_{12}^2}\vec{u}_r \tag{6}$$

which is the Newton's gravitational attraction force between two masses $m_1$ and $m_2$ separated by a distance $r_{12}$, and where $\vec{a}_2$ is the acceleration of the mass $m_2$ produced by the field $\vec{\Gamma}_1$ and $\vec{a}_2 = \vec{\Gamma}_1$. The minus sign in (6) indicates that the force is attractive.

In summary, the gravitational force would be transmitted through a polarization of the vacuum.

[1] José Francisco García Juliá, Gravitational Redshift, viXra: 0903.0001 [Relativity and Cosmology]
http://vixra.org/abs/0903.0001